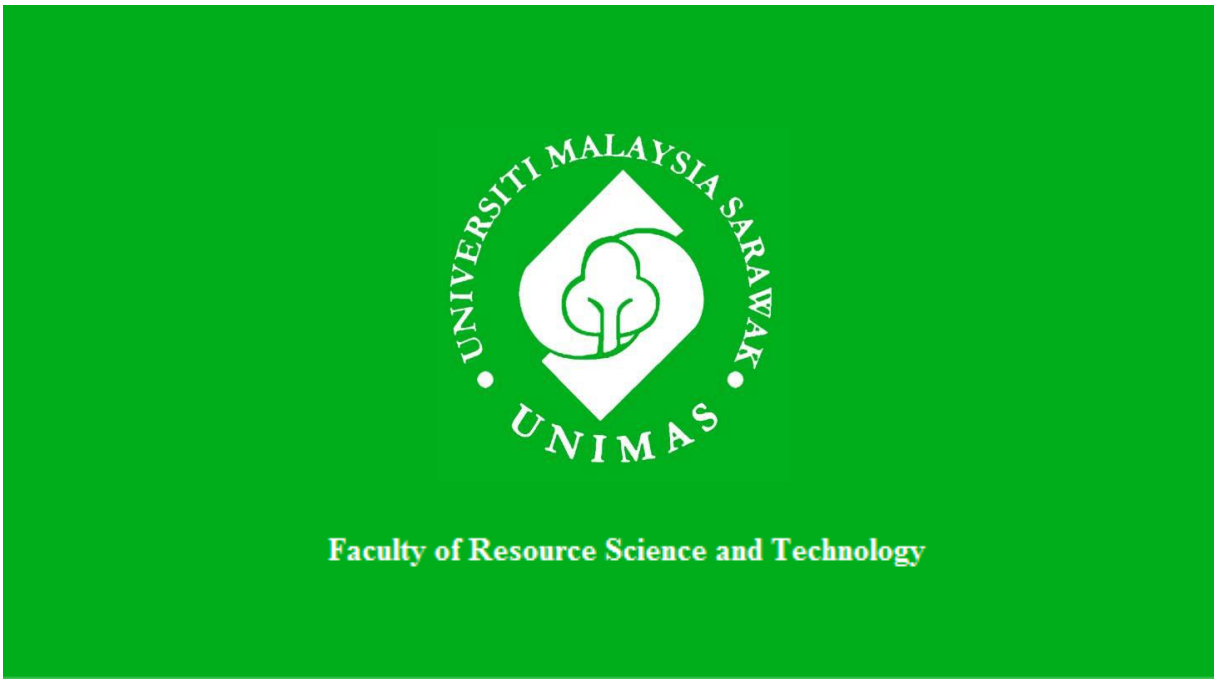

VEGETATIVE PROPAGATION OF TWO SELECTED LANDSCAPE TREE SPECIES BY STEM CUTTINGS

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Bachelor of Science with Honours
(Plant Resource Science and Management)
2017

UNIVERSITI MALAYSIA SARAWAK

Grade: _____

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Final Year Project Report	✓
Masters	
PhD	

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VEGETATIVE PROPAGATION OF TWO SELECTED LANDSCAPE TREE SPECIES BY STEM CUTTINGS

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This report submitted in partial fulfilment of the requirement for the Degree of Bachelor Science with Honours in Plant Resource Science and Management

Department of Plant Science and Environmental Ecology
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2017

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LIST OF ABBREVIATIONS

UNIMAS	- Universiti Malaysia Sarawak
FRST	- Faculty of Resource Science and Technology
PGR	- Plant Growth Hormone
IBA	- Indole-butyric acid
IAA	- Indole-acetic acid
NAA	- Naphthalene acetic acid
Mg/L	- Milligram per litre
NaOH	- Sodium hydroxide
Cm	- Centimetre
Mm	- Millimetre

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VEGETATIVE PROPAGATION OF TWO SELECTED LANDSCAPE TREE SPECIES BY STEM CUTTINGS

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ABSTRACT

For many landscape tree species, the production of rooting stock by seeds is not reliable due to difficulty in seed collection and at the same time some tree exhibit seed dormancy. Vegetative propagation by stem cuttings is one of popular alternative used by tree growers. This study was conducted to determine the rooting propensity of two different landscape trees which were *Tabebuia pentaphylla* and *Spathodea campanulata.* Three different concentrations of indole-butyric acid (IBA) (0, 100mg/L, 200mg/L, 500mg/L) and commercial rooting powder - SADEX® were applied on stem cuttings of three-year-old *T. pentaphylla* seedlings and one-year-old coppice shoot of *S. campanulata*. Another set of cuttings were not treated with IBA (as a Control). Forty cuttings of each species (20 with leaf and 20 without leaf) were used for each treatment and planted in Styrofoam cooler box (500mm x 383mm x 310mm – LxWxD) containing sieved river sand. The cuttings were assessed for their rooting for 14 weeks. The results show that PGR concentration significantly affected the rooting propensity for *T. pentaphylla* and *S. campanulata*. Overall rooting success of *T. pentaphylla* is 16.5% while *S. campanulata* is 28%. For *T. pentaphylla* cuttings treated with 100mg/L of IBA (22.5%) and untreated cuttings produced 25% of rooting success while for *S. campanulata*, 100mg/L of IBA produced 42.5% of rooting success. On number of roots, the overall analysis shows that PGR treatment (P=0.002), species (P=0.003) and interaction between PGR treatment with species (P=0.000) produced significant effect. It could be concluded that *S. campanulata* is much easier to root species compared to *T. pentaphylla*.

Keywords: Landscape tree, Stem cuttings, Plant growth regulator, Rooting propensity, Commercial rooting powder

ABSTRAK

Bagi kebanyakan pokok landskap, pengeluaran bekalan anak pokok dari biji benih adalah tidak boleh dipercayai kerana kesukaran untuk kutipan biji benih dan dalam pada masa yang sama terdapat beberapa pokok mempunyai dormansi biji benih. Pembiakan vegetatif dari keratan batang adalah salah satu alternatif yang popular digunakan oleh penanam pokok. Kajian ini telah dijalankan untuk menentukan kecenderungan pengakaran terhadap dua pokok landskap yang berbeza iaitu Tabebuia pentaphylla dan Spathodea campanulata. Tiga kepekatan hormon indole-butyric acid (IBA) (0,100mg/L, 200mg/L, 500mg/L) yang berbeza dan serbuk peransang pertumbuhan komersial - SADEX® telah digunakan pada keratan batang anak pokok berusia tiga tahun daripada T. pentaphylla dan pucuk baru S. campanulata yang berusia satu tahun. Satu set keratan batang tidak dirawat oleh IBA (bertindak sebagai kawalan). Empat puluh keratan setiap spesis (20 berdaun dan 20 tanpa daun) digunakan bagi setiap rawatan dan ditanam di dalam kotak pendingin styrofoam (500mm x 383mm x 310mm – LxWxD) yang mengandungi pasir sungai yang telah disaring. Pengakaran keratan batang dinilai selama empat belas minggu. Keputusan menunjukkan bahawa kepekatan PGR mempengaruhi kecenderungan pengakaran bagi T. pentaphylla dan S. campanulata. Keseluruhan kejayaan pengakaran bagi T. pentaphylla adalah 16.5% manakala bagi S. campanulata adalah 28%. Bagi T. pentaphylla keratan yang dirawat oleh 100mg/L IBA (22.5%) dan keratan yang tidak dirawat berjaya menghasilkan 25% pengakaran manakala bagi S. campanulata 100mg/L IBA berjaya menghasilkan 42.5% pengakaran. Untuk bilangan akar, keseluruhan analisa menunjukkan rawatan PGR (P=0.002), spesis (P=0.003) dan interaksi antara rawatan PGR dengan spesis (P=0.000) menghasilkan kesan yang ketara. Ianya boleh disimpulkan bahawa S. campanulata adalah lebih mudah untuk berakar berbanding T. pentaphylla.

Kata kunci: ***Pokok landskap, Keratan batang, Peransang Pertumbuhan Pokok, Kecenderungan pengakaran, Serbuk peransang pertumbuhan pokok***

2.0 INTRODUCTION

Many woody tree species have been planted as part of the landscape setting. Tree species act as shade in the parking, as well as wind breaker, produce a cooling effect to the environment. It is also grown for its attractive appearance. Ornamental trees are one of the necessity in landscaping. Ornamental plant has a lot of uses in environmental management and it has direct effect on the ecology and environment (Baiyewu *et al.,* 2005). Rapid urbanizations increase the demand for ornamental plants. Ornamental plants are needed for environmental beautification along the roadside, at the housing area, public playground and public park. Thus, production of ornamental trees in large quantities are needed in order to satisfy the demand requirement. Among the popular species planted include the Tecoma (*Tabebuia pentaphylla*) and African tulip tree (*Spathodea campanulata*).

Tabebuia pentaphylla (L.) Hemsl. or commonly known as pink trumpet tree is a species belongs to family Bignoniaceae (Brickell, 2010). It is also known as pink tecoma. *T. pentaphylla* is a native to most Carribean islands. It is a fast growing and evergreen tree. It produces trumpet shaped rose to lavender-pink flower.

Spathodea campanulate P. Beauv. or commonly known as African tulip tree is also a species belongs to family Bignoniaceae (Brickell, 2010). It is also known as flame of the forest. *S. campanulata* is a native to Africa. *S. campanulata* is an evergreen, showy tree. The flowers are tulip-shaped and it is normally in scarlet or orange red.

Most of the plant seedlings are grown by seeds. However, production of seeds of most tropical trees are inconsistent and extremely depending on the weather conditions (Ashton *et al.*, 1988). Therefore, the alternative way to produce stock plants is vegetative propagation by stem cuttings. Vegetative propagation by stem cuttings is a way or method which can be

used to produce a large quantities of stock plants. It is an approach of multiplying stock plants in a short period of time. It is also a technique to produce true-to-type progeny. According to Davies and Hartmann (1988), vegetative propagation by cutting is cheaper and easier to operate. However, Rugini and Fedeli (1990) stated that the major problem in vegetative propagation in some species and some varieties, they have poor rooting propensity. Garner and Chaudri (1976) and Hartmann *et al.* (1990) reported that several factors tend to influence the success of rooting cuttings, which include age of the mother plant, type and height of cutting, season of cutting, water content and ingredient of stock plant and cutting, and presence of vegetative buds or leaves on the cutting.

2.1 Problem statement

The demands of landscape are increasing as more housing areas are built. Naturally, most plants are produced through seed, but the flowering and fruiting are seasonal for some trees. At the same time seeds tend to develop seed dormancy. This will disrupt the continuous supply of seedlings. According to Springthorpe and Penfield (2015), the climate change has a dramatic effect on flowering plants and it has evolved to constrain when the seeds to produce some seeds that will be dormant and some will not.

Vegetative propagation by stem cuttings is one of the most potential alternative to ensure continuous supply of planting material for landscape species. However, there are very little information on rooting propensity of the species. Therefore, a study to find out the effective method to propagate this plant, the rooting by cutting will be conducted. Furthermore, this study is to know on how different PGR concentration affect the growth and propagation of two different types of landscape trees.

2.2 Objective

The objective of this research is

1. To determine the most effective concentration of PGR on rooting of stem cuttings.
2. To study the effect of leaf retention on rooting ability of the stem cuttings.

3.0 LITERATURE REVIEW

3.1 Botanical description

Tabebuia pentaphylla (L.) Hemsl.

Tabebuia pentaphylla is a species which belongs to family Bignoniaceae and it is commonly known as pink trumpet tree (Brickell,2010). *T. pentaphylla* is a native in northern South America. *T. pentaphylla* is a medium to large tree which can grow up to 37 m tall. It is broadly upright, fast growing, evergreen or deciduous tree with a long, smooth trunk. The bole is cylindrical and the bark is dark grey and rough, with vertical fissures. The leaves are compound, opposite with five small leaflets. Leaves are oblong to ovate-elliptic shape and it is also leathery and scaly (Brickell, 1998). The flowers are rose to lavender pink colour with trumpet shaped corolla.

Plate 3.1: *Tabebuia pentaphylla* tree

***Spathodea campanulate* P. Beauv.**

Common name of *Spathodea campanulata* is African tulip tree and it is known as flame of the forest tree (Brickell, 2010). *S. campanulata* is a species in family Bignoniaceae. It is native to Africa. *S. campanulata* is an evergreen tree with a bushy, oval crown. It can grow up to 25 m tall. It has two winged, airborne seeds which germinate freely (Polunin, 2009). Leafy tree with opposite, pinnate leaves. The flowers are tulip-shaped and it is normally in scarlet or orange red. It is grown for its showy, scarlet orange tulip-shaped flowers and large pinnate leaves.

Plate 3.2: *Spathodea campanulata* tree in UNIMAS

Plate 3.3: The flower of *Spathodea campanulata*

3.2 Vegetative propagation

Plant propagation is multiplication of plants by sexual (seed) and asexual (vegetative) means for the purpose of preserving the genotype. Sexual means the seed resulting from cross between two parent plants or male and female of a new plant from vegetative portion of the parent plant. Vegetative propagation uses its natural ability which involve in the separation of vegetative parts of plant tissue such as roots, shoots and leaves (Toogood, 1999). Vegetative propagation in plants helps in the production of identical plants in genotype with the mother plant (Hartmann *et al.,* 2002). To produce identical plant, the living cells which contain genetic information in the nuclei is necessary. This property is called totipotency.

There are several advantages of vegetative propagation. Hartmann *et al.* (2002) states that vegetative propagation shortens the plants maturation period of most seedling plants. It is an alternative way for species which is erratic in producing seed. Vegetative propagation is easy to operate and the cost to establish this technique is cheaper.

According to USDA (2012), plant can be asexually reproduced by using two or more plants in union or the same plants. Method to propagate asexually plant is categorized in two categories such as rooting and a plant union. Rooting is divided into five sub categories which are stock division, propagation by suckers, propagation by runners, layering and propagation by cuttings while plant union are propagation by grafting.

3.3 Stem cutting

Cutting can be described as a detached piece from parent plant, when placed in a suitable environment it will regenerate the lost part or tissue. Cutting is one of the way to produce true-to-type progeny. A portion of stem, root or leaf is cut from the parent or stock plant to form roots and shoots by manipulating chemical, mechanical or environmental variable (Hartmann *et al.,* 2002). This process also can shorten the juvenile phase. It is widely use in commercial greenhouse propagation. There are four categories in cutting which are leaf cutting, stem cutting, root cutting and leaf-bud cutting. Stem cutting is most commonly used method of cuttings. Stem cuttings are cutting which consists of lateral or terminal buds. According to Ruter (2014), stem cutting can be categorized in five different classes which are deciduous hardwood cuttings, narrow-leaf evergreen hardwood cuttings, semi-hardwood cuttings, softwood cuttings, and herbaceous cuttings. Luna and Haase (2014) stated that cuttings should be collected on cool days during early in the morning and it need to be kept cool during collection to avoid transpiration and physical damage.

Success of rooting of stem cuttings had been proven in previous study. Based on previous study it is stated that vegetative propagation through stem cuttings is more successful compare to micro propagation (Shokri *et al.,* 2012). As an example, bottlebrush plant results in rapid rooting when propagate by stem cuttings. Bottlebrush plants are usually propagated through seed or layering. The study of vegetative propagation by stem cutting of bottlebrush plant is easy to operate and reduce the time taken to produce the stock plants (Shokri *et al.,* 2012).

3.4 Factors affecting rooting of cutting

Initiation of roots on cutting can be affected by external and internal factors. Different plant species has different response on the factors. There are many factors which will affect rooting on cutting such as light intensity, retention of leaves, plant growth regulator hormone, moisture and type of rooting media. Plant growth regulator hormone and retention of leaves are the main factors which will be emphasize in this experiment.

3.4.1 PGR concentrations

Chemicals produced by any part of plants that regulate growth processes inside them are called hormones. They play crucial role in developing and shape the plant. They can be stratified into two which are phytohormone (natural hormone occurring in plant) and synthetic plant hormone. Phytohormone is not secreted by special glands like in animals but by some parts in plant which are buds and leaves. There are five natural hormones produced in plants which are auxin, gibberellin, cytokinin, abscisic acid and ethylene (Hartmann *et al.*, 2002). Meanwhile, synthetic plant hormones are synthetic compound that act like natural plant hormone are called plant growth regulators that are low in concentrations which encourage the plant's cell and tissue growth and development (Wiesman *et al.*, 1989). Hartmann *et al.* (2002) stated that PGR such as Indole-acetic acid (IAA), Indole-butyric acid (IBA), and Naphthalene acetic acid are commonly used in cutting propagation to encourage roots growth. They function as regulator mostly enhancing the production of roots by clumping of carbohydrate at the end of the cuttings. Nakhooda *et al.* (2011) proved that IBA is the most stable PGR than IAA and NAA in root induction of cuttings of *Eucalyptus grandis* and Wiesman *et al.* (1989) also stated that IBA rapidly metabolized in cuttings.

A study by Fadwa and Yahia (2014) on *Peltophorum petrocarpum* plants state that cutting treated with 200mg/L of IBA produced an 56.7% rooting compare to other concentration. However, contradict result was obtained by Shokri *et al.* (2012) whereby cuttings which is treated with 2000mg/L of IBA produce a higher rooting percentage. According to Aminah *et al.* (2006), cuttings of *Shorea parvifolia* treated with 8000mg/L of IBA produce the highest rooting propensity however the cuttings of *Shorea macroptera* treated with 10000mg/L of IBA produce the highest rooting propensity. Baul *et al.* (2011) stated that cuttings of *Litsea monopetala* which is treated with 1000mg/L of IBA has the highest rooting response while cutting treated with 4000mg/L of IBA produced the lowest rooting response. Therefore, concentration of IBA can influence the rooting propensity of cuttings whether it is low or high concentration. Concentration of IBA may enhance or inhibit the rooting of cuttings and it also may have no effect to the cuttings.

3.4.2 Retention of leaves

Leaf retention is an important factor which will affect the rooting on vegetative cuttings. Cuttings which are retaining the leaves will root better. Leafy cuttings occupy more bench space than leafless cuttings which will affect the efficient use of propagating facilities. According to Marcotrigiano and McGlew (1990), before the cuttings are placed under the mist, the leaf surface area is frequently reduced. Leaves provide carbohydrate, auxin, and rooting cofactors. Carbohydrate is one of the component which contribute to root formation (Hartmann *et al.,* 2002). The removal of leaves can affect the rooting on cuttings.

Based on the previous study by Zhou *et al.* (2009), that leafless *Tetranea mongolia* is unable to produce roots compared to cuttings of *Tetranea mongolia* which has leaves. Larger leaf

surface area influences the higher ability for the cuttings to photosynthesize. According to Reuveni and Raviv (1980), the faster rooting process is contributed by the retention of the leaves and cuttings which retained the leaves longer have the tendency to root faster.

3.4.3 Light intensity

Light is one of the important factors in order to generate photosynthesis and other biochemical process in plant cell. Providing light for photosynthesis is necessary in order for the cuttings continue to manufacture food during rooting. Hossain and Kamaluddin (2011) stated that light intensity greatly affects the growth and morphology of shoots and rooting ability of cuttings. According to a study conducted by Safeer *et al.* (2013), plants which is grown under 50% shade net with average light intensity is the best for maximum growth. Moderate light intensity can contribute in improving the photosynthetic activity of the cuttings. Factors which will affect the successfulness of rooting ability in most plant are low light intensity and high shading area (Hossain & Kamaluddin, 2011). Hence, an area which provide low light intensity and high shading area is suitable for vegetative propagation by stem cuttings.

3.4.4 Rooting media

Rooting media is very important in order to promote rooting. The suitable rooting medium for any species is the one that reduces respiration losses, provides high humidity and lowers the air temperature. Tchoundjeu *et al.* (2002) proved that sand as rooting medium is better than sawdust in the first 5 weeks. This is because sand has higher water retention compared to sawdust and retains moisture in the medium (Mésen *et al*., 1997). According to Topacoglu